भारतीय मानक
Indian Standard

IS 17368 : 2020

भूकृत्रिम — अधिष्ठापन के दौरान भूकृत्रिम की क्षति ज्ञात करना

Geosynthetics — Determination of Damage to Geosynthetic Caused During Installation

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Geosynthetics Sectional Committee, TXD 30

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Geosynthetics Sectional Committee had been approved by the Textile Division Council.

The geosynthetic which is used for roads, RE walls and other installation goes under severe compressive and shearing action during installation and results in damage to geosynthetics due to compressive and rubbing action of aggregates and gravels etc. This damage causes loss in its required strength. To quantify the damage, a loss in strength is determined by this method.

Keeping view of the damage caused during installation or loss in strength the safety factor (reduction factor) is calculated. Based on the reduction factor the required strength (nominal strength × reduction factor) is demanded by the user.

In the formulation of this standard, assistance has been drawn from the following International Standards/ Publications:

International Standard/ Other publication	*Title*
ISO 10722 : 2019	Geosynthetics — Index test procedure for the evaluation of mechanical damage under repeated loading — Damage caused by granular material (laboratory test method)
ISO 13437 : 2019	Geosynthetics — Installing and retrieving samples in the field for durability assessment
BS 8006-1 : 2010	Code of practice for strengthened/reinforced soils and other fills

The preparation of installation of geosynthetic sample on site is in accordance with this standard, however actual amount of fill and loading may vary which may be agreed by the user. It is sole responsibility of the user to exhume the geosynthetic sample carefully without damaging it further. The evidence of installation and exhuming geogrid sample is must and can be provided by the user.

The composition of the Committee responsible for the formulation of this standard is given in Annex B.

In reporting the result of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS 2 : 1960 ‘Rules for rounding off numerical values (*revised*)’.

Indian Standard

GEOSYNTHETICS — DETERMINATION OF DAMAGE TO GEOSYNTHETIC CAUSED DURING INSTALLATION

1 SCOPE

This test method describes the procedure for installation of geosynthetic sample as per site specific requirements and exhuming it without further damage for testing in laboratory. Mainly tensile strength is determined before and after damage during installation. The strength retained after installation is determined.

2 REFERENCES

The standards listed in Annex A contain provisions which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards.

3 TERMS AND DEFINITIONS

For the purpose of this standard, the definitions given in SP 45 and IS 13321 (Part 1) in addition to the following shall apply.

3.1 Geogrid — A synthetic planar structure formed by a regular network of tensile strength elements with apertures of sufficiently large size to allow for interlocking with the surrounding soil so as to perform the primary function of reinforcement. *Geogrids* are commonly used to reinforce retaining walls, as well as sub-bases or sub-soils below roads or structures.

3.2 Geosynthetics — Geosynthetic is a planar product manufactured from a polymeric material that is used with soil, rock, or other geotechnical-related material as an integral part of a civil engineering project, structure, or system.

3.3 Apertures — The open spaces formed between the interconnected network of longitudinal and transverse ribs of a geogrid.

3.4 Ribs — Rib is a single element of geogrid in transverse and longitudinal directions which hold the grid structure together providing dimensional stability.

3.5 Longitudinal Ribs — The continuous elements of a geogrid which are in the machine direction as manufactured, or in the major principal stress direction as placed in the field.

3.6 Transverse Ribs — The continuous elements of a geogrid which are in the cross machine direction as manufactured, or in the minor principal stress direction as placed in the field.

3.7 Strike-Through — The ability of the soil backfill to be continuous through the apertures of the geogrid allowing for bearing capacity against the transverse ribs.

3.8 Junctions (or Nodes) — The interconnections between the longitudinal and transverse ribs of a geogrid which hold the grid structure together providing dimensional stability and load transfer mechanisms.

3.9 Connections — The connections made between separate geogrid rolls or between geogrids and wall panels or other parts of the structural system.

3.10 Design Strength — The design, or required, strength of a geogrid needed for successful functioning of the system. It is often arrived at by an appropriate geotechnical design model.

3.11 Ultimate Geogrid Strength — The ultimate or maximum geogrid strength, as determined by a short-term strength test either by single rib or multi rib method.

3.12 Allowable Geogrid Strength— The long-term, allowable strength, Tallow, to be used in design taking into account all of the phenomena which could influence the geogrid during its service lifetime.

3.13 Reduction Factors — A set of numeric values each of which is focused on a particular phenomenon which may adversely impact the geogrid's performance.

4 SITE DAMAGE TEST

4.1 General

Coarse backfills and heavy compaction loads can damage geosynthetic, causing an immediate reduction in strength. The effect is referred to as installation damage and the corresponding reduction factor as RF_{ID}.

The purpose of the site damage test shall be:

a) to place the geosynthetic under a range of fills that conform to the grading limits and to compact those fills in accordance with and in excess of the required specification;

b) to recover the geosynthetic and measure its tensile strength and estimate the site damage; and

c) quantify any loss of strength of the geosynthetic due to the construction process.

4.2 Test Site

4.2.1 Measurement of the effect of installation damage on geosynthetic reinforcement strength and deformation shall be determined from the results of installation damage tests. The installation damage tests shall simulate the installation conditions (conditions of service) as closely as practicable to the installation conditions anticipated in the geosynthetic structure. The installation conditions to be simulated shall include, as a minimum:

a) the nature of the backfill both below and above the sample, particle size distribution, hardness and angularity;

b) the depth at which the sample is installed;

c) whether the material is driven over by vehicles before compaction; and

d) method and degree of compaction.

4.2.2 Test results from damaged specimens shall be compared to tensile test results obtained from undamaged specimens taken from the same lot, and preferably the same roll, of material as the damaged specimens.

4.2.3 The specimens shall be large enough to be used for wide-width tensile testing (*see* IS 16635). Consideration shall be given to increase the number of specimens to ensure that they are fully representative of the damaged material. In case of geogrid, it is desirable that multi-rib tests, with at least four ribs, shall be used for installation damage evaluation. With single rib testing it may be difficult to assess the effect of severed ribs on the strength and modulus of damaged materials, and the effect of differences in degree of damage between ribs on the overall tensile strength of the product. Single ribs of geogrids are generally unsuitable for installation damage testing. If this cannot be avoided, for example, for very high strength materials, then it shall be demonstrated that the strength of the single ribs is representative of the full product.

4.2.4 A level site shall be prepared and laid out in nine bays each 3.5 m × 3.5 m as shown in Fig. 1, leaving working space for construction plant to gain access around the test area without crossing the bays.

4.2.5 Where the reinforcement is planned to be used within a zone of compacted fill, for example, a reinforced soil retaining wall or fill slope, a 150 mm thick layer of material (or 1.5 times the maximum fill size, whichever is the greater) shall be placed and compacted in each bay prior to the installation of the reinforcement. This material shall be the same as that to be placed in the layer above the reinforcement.

Where the reinforcement is planned to be used beneath a zone of compacted fill, for example, a basal reinforced embankment on soft soil, a 150 mm thick layer of the typical foundation soil (or 1.5 times the maximum fill size, whichever is the greater) shall be placed in each bay prior to the installation of the reinforcement.

4.3 Arrangement of the Reinforcement

Sufficient portions of reinforcement each 10.5 m long (or as appropriate) shall be prepared. These shall be placed across each bay as shown in Fig. 1. No tension shall be applied to the reinforcement. The QC roll number and/or batch number of the reinforcement shall be recorded. Sufficient unused reinforcement from this batch shall be retained and prepared for tensile testing as control samples.

4.4 Fill Materials

Three different gradings of the fill material proposed for use shall represent the coarse, medium and fine fill. The fill material may be frictional fill, cohesive frictional fill or other materials as specified in the relevant product standard. Each layer of material shall be compacted to a thickness of 150 mm or 1.5 times the maximum particle diameter, whichever is greater. Particle size distribution for each type of fill shall be determined by dry sieve analysis. Fill shall not be end tipped onto the reinforcement but shall be spread over by bulldozer.

4.5 Compaction

Compaction of the fill shall be carried out as per guide line or specifications. The roller mass per metre width and number of passes shall be selected as per guide line or specifications (generally 10 ton vibratory type roller is used which imparts 30 ton load with 10 passes).

4.6 Site Testing

The reinforcement shall be subjected to a variety of fill materials and compactive efforts as shown in Fig. 1. Levels shall be taken on a 1 m^2 grid within each bay after completion of each layer to determine the mean layer thickness. Variations in surface levels of the compacted fill shall not exceed 30 mm and 20 mm of the true finished level as measured on a 1 m^2 grid.

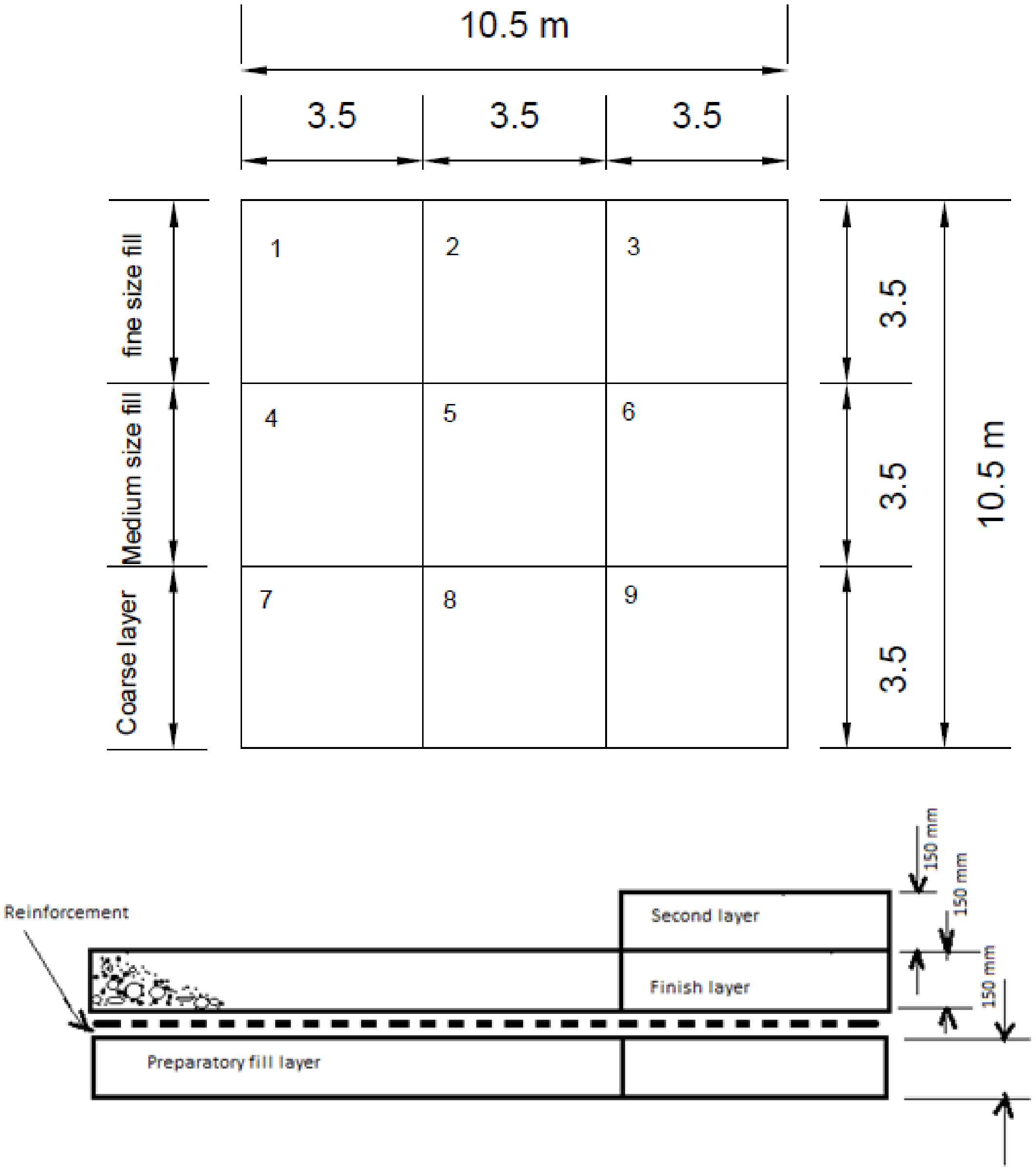

FIG. 1 SCHEMATIC LAYOUT OF TEST BAYS

4.7 Preparation of Samples

Three specimens shall be prepared from each length of the geosynthetic for visual assessment of site damage and tensile testing. The following general guidelines shall be followed unless otherwise agreed by the parties concerned:

a) The number of samples is determined by the dimensions of the structure, the physical variations in the environment in which the geosynthetic is installed, and the repercussions that a failure of the geosynthetic function would cause.

b) The number of retrievals depends on the expected service life of the geosynthetics.

c) The following schedule shall be observed unless otherwise agreed:

   1) prepare durability testing samples and take control samples on delivery of material; and

   2) make a first retrieval directly following construction.

d) The samples shall be subjected to the same physical environment to which the geosynthetics is exposed in the structure.

e) The dimensions of the durability testing samples shall be in accordance with dimensions and type of grip in tensile testing machine. Avoid folding or cutting if possible. A copy of the geosynthetics identification, date and structure reference, product delivery reference label is to be placed along with sample.

4.8 Recovery of the Reinforcement

After completion of the site testing, the compacted fill shall be manually removed from all bays. Those pieces of reinforcement that are accidentally damaged by spades shall not be used in subsequent tests.

4.9 Visual Assessment of Site Damage

A visual assessment of the site damage to each sample shall be made and recorded. Damage shall be classified into following categories.

a) *General Abrasion* — This describes the condition of the reinforcement when damaged by contact with many small stones which leave the surface of the reinforcement covered in small scratches and abrasions.

b) *Splits, Cuts, Bruises and Coating Removal* — This describes the damage caused by the action of larger particles.

    1) A split shall describe the region of a strip or rib when locally split into a number of small strands so that light passes through.

    2) A cut shall describe the rib or strip when a sharp indentation is made across or along the reinforcement, such that fibres are cut or the cross-section of the rib is reduced.

    3) A bruise shall describe the rib or strip when flattened but no light passes through.

    4) Coating removal applies when the coating or sheath has been removed locally, leaving the reinforcing fibres visible. Visual inspection of the coatings of metallic reinforcements shall be same as that made for polymeric reinforcements.

4.10 Reinforcement Test Method

The reinforcement shall be tested in accordance with the method specified in IS 16635. For reinforcements, it is sufficient to cut parallel specimens. Both the control samples and damaged samples shall be tested.

The tensile strength, peak extension and the classified damage shall be reported for each site damaged specimen and comparisons made with the properties of the control sample.

NOTE — In case of uni-axial geogrid testing shall be done in machine direction only and in case of extruded (or bi-axial) geogrid, testing shall be done both in machine as well as cross machine direction.

5 TESTING AND ANALYSIS

5.1 Testing on Retrieval Samples

Wash the samples carefully under running cold tap water and place them horizontally to dry. Tensile strength test in accordance with IS 16635 shall be performed on the sample.

5.2 Compare the results of these tests with those obtained on control specimens that is, determine the strength retained (in percentage) after damage during installation.

6 TEST REPORT

The test report shall include:

a) Sample details like, grade, type, manufacturers name, lot number, roll number etc;
b) Project details, location (site);
c) Type of soil/sand, gravel, aggregates used;
d) The identification of the initial conditions;
e) The retrieval operation;
f) The laboratory report (strength retained and reduction factor); and
g) Any other information required by the user.

ANNEX A

(*Clause* 2)

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*
13321 (Part 1) : 1992	Glossary of terms for geosynthetics: Part 1 Terms used in materials and properties
16635 : 2017	Geosynthetics — Wide width tensile test
SP 45 : 1988	Hand book on glossary of textile terms

ANNEX B

(*Foreword*)

COMMITTEE COMPOSITION

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The South India Textile Research Association Council, Coimbatore	DR A. N. DESAI (***Chairman***)
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